

# IC Severe 4 Teletraining Study Guide

## Case #1 Instructional Objectives

### Section 1: Environmental Assessment

#### 1. Convective Forcing: Given the following mechanisms for forcing, determine and explain the expected coverage and convection on 21 July 2003.

- Near surface frontogenesis - Sharpening north-south trough
- Frictional effects - May have been a minor player
- Midlevel frontogenesis - diagnosis from RUC showed not a factor
- Differential vorticity advection - Small scale, MCV-like shortwave trough was main forcing mechanism by rapidly destabilizing the airmass
- Warm advection - more of a factor farther west in OH/WV
- Topographic lifting - Possible, but convection that formed would have taken shape of the best topographic lifting

#### 2. Storm Mode: What mode was most likely for convection on 21 July 2003 in the strongest threat area?

- Organized linear or isolated supercells most likely based on environmental shear values

#### 3. Storm Mode: What were the main considerations for arriving at the mode of isolated convection?

- Strong shear oriented normal to boundary suggest linear modes would be strong
- Any isolated convection would be supercellular, probably HP
- Isolated convection would be stronger north and east (in BGM) and more marginal south and west (in CTP)
- The development of a trailing stratiform region was more likely in CTP than in BGM
- If there was cell consolidation, a parallel stratiform precipitation MCS more likely than trailing in both CWAs

#### 4. Specific Threat: Determine the relative threats from specific hazards from the BGM and CTP CWAs and explain your reasoning.

##### HAIL (15%)

Pro: Moderate deep shear supports some large hail

Con: Weak buoyancy below  $-20^{\circ}\text{C}$  may limit production of very large hail

##### WIND (25%)

Pro: Moderate deep shear enhances threat from RFDs and QLCS vortices; Strong 1-3 km AGL winds support wind threat from momentum mixing; and Strong forcing for convection imply high coverage and organized multicell modes

Con: DCAPE is relatively small limiting wet/hybrid microburst potential; and RIJ damage contingent on significant trailing stratiform precipitation

##### TORNADOES (15%)

Pro: Increasing 0-1 km shear due to cyclogenesis (20-25 kts); Low LCLs (600-800 m) is optimal; and Low CIN and good low-level lapse rates support enhanced threat

##### HEAVY RAIN (small)

Pro: Rapid rain rates supported to high updraft mixing ratios and low LCLs

Con: Fast moving system will limit duration

## **Section 2: Storm Interrogation**

### **1. Conceptual Models of Vortices in Potter and McKean Counties**

These vortices fit with the QLCS vortex morphology described by Przybylinski; Trapp and Weisman 2003. They are typically non descending vortices embedded in a region of strong vertical vorticity sheet along a steeply sloped gust front interface. Their motion is closer to the 0-6 km mean wind than with the right supercell motion vector.

### **2. Severe Winds Associated with a MCV in McKean and Elk Counties**

This section was not covered in the teletraining and will not be tested.

### **3. Assess Updraft Strength with Satellite Near Union County**

This section was not covered in the teletraining and wil not be tested.

### **4. Wind and Hail Potential in Tioga County**

The Tioga county storm had a small bow echo in a favorable environment, a local updraft max, and a weak MARC signature. The MARC signature could have been stronger, however, with a better positioned radar, given the bow and local updraft maximum. A severe event ( $> 64$  kts) wasn't expected as  $\Delta V$  was less than 50 kts.

Only marginal severe hail is expected as there is little evidence of a sustained supercell updraft. The updraft above the  $-20^\circ$  C level is weak. Marginally severe hail, falling from high elevations, will be susceptible to melting.

### **5. Assess All Hazards in Union County**

A good MARC signature formed with the updraft pulse and then expanded as it traveled northeast. This is where the most intense damage would occur in a bow echo as the ensuing downburst hit the ground. Note that the VIL decreased as the bow matured and the updraft column shrunk. There was also a secondary rear inflow notch and formation of a QLCS type vortex on the left side of the outflow segment. Given a favorable environment and this feature, a tornado threat was likely along with enhanced winds (i.e.,  $\Delta V > 50$  kts on 3 elevation angles).

## **Case #2 Instructional Objectives**

### **Section 1: Threat Assessment (12-18z)**

- **Analyze 12z-18z data, evaluate pattern & sounding parameters, analyze 12z model forecast, and make initial threat assessment: likelihood of mode and hazard(s)**
  - Pattern - Coastal Trough-Inland Ridge (CTIR) pattern conceptual model
  - Differential vorticity advection - Several short-waves rotating around the larger trough at 500 mb
  - Near surface frontogenesis - A warm front was located across southern Idaho and Wyoming between 12-18 UTC; A cold front was moving from California into Nevada and SW Idaho
  - Topography - Low-level flow was funneled down the Snake River valley, which increased SRH in eastern Idaho just north of the warm front
  - Initial assessment - This pattern is indicative of severe weather occurring in eastern Idaho (PIH CWA)

### **Section 2: Short-term Threat Assessment (18-21z)**

1. **Identify mesoscale lifting mechanisms (from 18z RUC)**
  - Surface warm front and midlevel differential vorticity advection

- 2. Identify local regions of instability and shear from LAPS data which could affect updraft development and subsequent morphology**
  - If multicell storms form, the likely cold pool motion would be in the downshear direction (i.e., forward propagation)
  - Model forecast SRH values are underforecast due to the model not accurately analyzing low-level flow in Snake River valley
  - Radar mosaics indicated that storms weren't showing any linear organization in PIH CWA, but were mostly clustered individual cells with a few possible supercells
- 3. Determine approximate timing, location, and movement of severe convection**
  - Because of terrain issues, the model's storm motion vectors for right-moving supercells (i.e., Bunkers technique) were a little off, which impacted the model SRH values
- 4. Refine threat assessment (hazards)**
  - HAIL: Decent. CAPE values were low, but there were steep lapse rates in the hail growth zone.
  - WIND: Marginal. No organized multicell structures were present in these storms. None of the individual storms appeared to be supercells with RFDs at this point. If storm developed RFDs, then wind threat would increase.
  - TORNADO: Decent-to-Significant. Radar data suggested that some storms were developing supercell characteristics. As these storms moved north of warm frontal boundary, SRH should increase and may enhance low-level mesocyclogenesis. Needed to watch storms as they moved into that region.
  - FLASH FLOOD: Marginal at best. Storms were moving quickly and there was no indication of storms training. Environmental assessment earlier determined that moisture content was not high at lower-levels.
- 5. Determine counties in potential watch**
  - Mainly PIH and eastern portion of BOI's CWA.

### **Section 3: Storm Interrogation (20-23z)**

- 1. Demonstrate how you would rank storms**
  - Storms in southern Minidoka and northern Cassia counties would be ranked #1, # 2.
- 2. Evaluate all-hazards with each storm**
  - Main storm passed within 50 km of the KSFX radar (PIH CWA)
  - Storm exhibited many signatures common with tornadic supercells, including a mesocyclone with a TVS, a BWER, an inflow notch, hook echo, and low-level convergence at  $0.5^{\circ}$
  - Storm's supercellular traits also suggest an elevated severe hail threat, with 50+ dBZ cores at  $5.3^{\circ}$ , which was near the  $-20^{\circ}\text{C}$  isotherm level on this day
  - Several tornadoes and hail up to golfball size were reported with this storm
- 3. Make watch/warning decisions**
  - A tornado warning on the Cassia County storm as it was moving into Power County would be warranted based on radar trends.
- 4. Identify products and procedures for effective monitoring of all threats**
  - 4-panel radar with Z/SRM , plus METARS showing boundary.